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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|-------------------------------|-------------|----------------------|---------------------|------------------|
| 10/660,573 | 09/12/2003 | Ming-Tsong Wang | 0941-0841P | 5290 |
| 2292 | 7590 | 04/21/2004 | EXAMINER | |
| BIRCH STEWART KOLASCH & BIRCH | | | MALDONADO, JULIO J | |
| PO BOX-747 | | | ART UNIT | PAPER NUMBER |
| FALLS CHURCH, VA 22040-0747 | | | 2823 | |

DATE MAILED: 04/21/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

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|------------------------------|--------------------------------|------------------|--|
| Office Action Summary | Application No. | Applicant(s) | |
| | 10/660,573 | WANG ET AL. | |
| | Examiner Julio J. Maldonado | Art Unit 2823 | |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) Responsive to communication(s) filed on ____.
- 2a) This action is **FINAL**. 2b) This action is non-final.
- 3) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) Claim(s) 1-40 is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) Claim(s) ____ is/are allowed.
- 6) Claim(s) 1-40 is/are rejected.
- 7) Claim(s) ____ is/are objected to.
- 8) Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) The specification is objected to by the Examiner.
- 10) The drawing(s) filed on ____ is/are: a) accepted or b) objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 - a) All b) Some * c) None of:
 1. Certified copies of the priority documents have been received.
 2. Certified copies of the priority documents have been received in Application No. ____.
 3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) Notice of References Cited (PTO-892)
- 2) Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
 Paper No(s)/Mail Date 09/12/2003.
- 4) Interview Summary (PTO-413)
 Paper No(s)/Mail Date. ____.
- 5) Notice of Informal Patent Application (PTO-152)
- 6) Other: ____.

DETAILED ACTION

Claim Rejections - 35 USC § 112

1. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

2. Claims 1 and 14 rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claim 1 recites, "...providing a plasma treatment to remove remaining impurities...". However, there is no description prior in the claim of impurities being formed on the dielectric layer. Also, claim 14 recites, "...wherein the plasma treatment repairs the bonding between the first metal layer and the dielectric layer...". However, there is no description of a bonding being formed between the metal layer and the dielectric layer and that said bonding is broken at some part during the manufacturing process.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 1-33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wu et al. (U.S. 6,013,581, hereinafter Wu.1) in view of Wu et al. (U.S. 2003/0022513 A1, hereinafter Wu.2).

Wu.1 (Figs.2A-2E) in a related method to form a damascene structure teaches providing a substrate (200); forming a metal layer (202) on the substrate (200) comprising copper; forming a cap layer (204) comprising silicon nitride on the substrate (200); forming a dielectric layer (206, 208, 210) on the cap layer (204); etching the dielectric layer (206, 208, 210) to form a damascene opening (218) by patterning said dielectric layer (206, 208, 210) obtaining a via and a trench over the via; providing a plasma treatment, wherein the plasma used comprises hydrogen, nitrogen, ammonia or nitrogen oxide; and filling a second metal (226) comprising copper on the damascene opening (218) (column 2, line 50 – column 3, line 65).

Wu.1 fails to teach wherein said etching process comprises a plasma process using fluorine containing plasma; and wherein said plasma treatment is to remove impurities on the dielectric layer. However, Wu.2 (Figs.3A-3B) in a related method to form interconnects teaches providing a substrate (300); forming a cap layer (302) on the substrate (300); forming a dielectric layer (306) on the cap layer (302); etching the dielectric layer (306) comprising an anisotropic plasma etch using a fluorine containing plasma, the plasma creating impurities on the dielectric layer (306); and providing a plasma treatment comprising a hydrogen containing gas, a nitrogen containing gas and an oxygen containing gas or mixtures thereof to remove said impurities from the dielectric layer (306) ([0021] – [0035]). It would have been within the scope of one of ordinary skill in the art to combine the teachings of Wu.1 and Wu.2 to enable the etching process of Wu.1 to be performed according to the teachings of Wu.2 because one of ordinary skill in the art at the time the invention was made would have been motivated

to look to alternative suitable methods of performing the disclosed etching process of Wu.1 and art recognized suitability for an intended purpose has been recognized to be motivation to combine. MPEP 2144.07.

The combined teachings of Wu.1 and Wu.2 fail to teach wherein the plasma treatment repairs the bonding between the first metal layer and the dielectric layer. The same material would be treated in the same manner and therefore the recited results would be obtained.

5. Claims 34-40 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wu et al. (U.S. 6,013,581, hereinafter Wu.1) in view of Wu et al. (U.S. 2003/0022513 A1, hereinafter Wu.2) and Huang (2002/0054962 A1).

Wu.1 (Figs.2A-2E) in a related method to form a damascene structure teaches providing a substrate (200); forming a metal layer (202) on the substrate (200) comprising copper; forming a cap layer (204) comprising silicon nitride on the substrate (200); forming a dielectric layer (206, 208, 210) on the cap layer (204); etching the dielectric layer (206, 208, 210) to form a damascene opening (218) by patterning said dielectric layer (206, 208, 210) obtaining a via and a trench over the via; providing a plasma treatment, wherein the plasma used comprises hydrogen, nitrogen, ammonia or nitrogen oxide; and filling a second metal (226) comprising copper on the damascene opening (218) (column 2, line 50 – column 3, line 65).

Wu.1 fails to teach wherein said etching process comprises a plasma process using fluorine containing plasma; and wherein said plasma treatment is to remove impurities on the dielectric layer. However, Wu.2 (Figs.3A-3B) in a related method to

form interconnects teaches providing a substrate (300); forming a cap layer (302) on the substrate (300); forming a dielectric layer (306) on the cap layer (302); etching the dielectric layer (306) comprising an anisotropic plasma etch using a fluorine containing plasma, the plasma creating impurities on the dielectric layer (306); and providing a plasma treatment comprising a hydrogen containing gas, a nitrogen containing gas and an oxygen containing gas or mixtures thereof to remove said impurities from the dielectric layer (306) ([0021] – [0035]). It would have been within the scope of one of ordinary skill in the art to combine the teachings of Wu.1 and Wu.2 to enable the etching process of Wu.1 to be performed according to the teachings of Wu.2 because one of ordinary skill in the art at the time the invention was made would have been motivated to look to alternative suitable methods of performing the disclosed etching process of Wu.1 and art recognized suitability for an intended purpose has been recognized to be motivation to combine. MPEP 2144.07.

The combined teachings of Wu.1 and Wu.2 teach using a photoresist to perform the patterning of the dielectric layer (Wu.1, column 3, lines 20 – 35), but fail to expressly teach wherein said photoresist contains carbon. However, Huang in a related method to form an interconnect structure teaches using organic photoresists as part of the patterning process in the formation of said interconnects ([0004]). It would have been within the scope of one of ordinary skill in the art to combine the teachings of Wu.1 and Wu.2 with the teachings of Huang to enable patterning the dielectric layer of the combined teachings of Wu.1 and Wu.2 to be performed according to the teachings of Huang because one of ordinary skill in the art at the time the invention was made would

have been motivated to look to alternative suitable methods of performing the disclosed patterning step of Wu.1 and Wu.2 and art recognized suitability for an intended purpose has been recognized to be motivation to combine. MPEP 2144.07.

Conclusion

6. Any inquiry of a general nature or relating to the status of this application should be directed to the Group Receptionist whose telephone number is 571-272-2800. See MPEP 203.08.
7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to examiner Julio J. Maldonado whose telephone number is (571) 272-1864. The examiner can normally be reached on Monday through Friday.
8. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri, can be reached on (571) 272-1855. The fax number for this group is 703-872-9306 for before final submissions, 703-872-9306 for after final submissions and the customer service number for group 2800 is (703) 306-3329.
Updates can be found at <http://www.uspto.gov/web/info/2800.htm>.

Julio J. Maldonado
Patent Examiner
Art Unit 2823

Julio J. Maldonado
April 17, 2004



W. DAVID COLEMAN
PRIMARY EXAMINER